FEMA Report to Congress

on the Technical Mapping Advisory Council's Recommendations from 2015

June 8, 2017

Homeland Security

FEMA

Message from the Acting Administrator

I am pleased to present the "Report to Congress on the Technical Mapping Advisory Council's Recommendations from 2015."

The Federal Emergency Management Agency (FEMA) prepared this document pursuant to section 215 of the Biggert-Waters Flood Insurance Reform Act of 2012 codified at 42 U.S.C § 4101a.

Pursuant to congressional requirements, this report is being provided to the following Members of Congress:

- The Honorable Michael Crapo, Chairman, Committee on Banking, Housing, and Urban Affairs, United States Senate
- The Honorable Sherrod Brown, Ranking Member, Committee on Banking, Housing, and Urban Affairs, United States Senate
- The Honorable Jeb Hensarling, Chairman, Committee on Financial Services, United States House of Representatives
- The Honorable Maxine Waters, Ranking Member, Committee on Financial Services, United States House of Representatives

Inquiries relating to this report may be directed to the FEMA Congressional Affairs Division at (202) 646-4500.

Sincerely

Robert J. Fenton
Acting Administrator

Executive Summary

On July 6, 2012, Congress passed the Biggert-Waters Flood Insurance Reform Act (BW-12), authorizing the National Flood Insurance Program (NFIP) for five years and enacting substantial reforms and defining new legislative requirements for a national flood mapping program. Additional legislation, passed on March 21, 2014, known as the Homeowner Flood Insurance Affordability Act (HFIAA), repealed and modified certain provisions of BW-12 and made additional changes to the NFIP. Collectively, these Acts authorize a national flood mapping program with several major expansions in scope and enhancements to community engagement and risk communications. The mapping program is implemented in coordination with the Technical Mapping Advisory Council (TMAC), a Federal advisory committee comprised of representatives of federal, state, local, and private industry as well as tribal and other subject matter experts. The TMAC was established by BW-12, and in accordance with the provisions of the Federal Advisory Committee Act (FACA), 5 U.S.C. App. (92).

Congress directed the TMAC to develop recommendations for the FEMA Administrator regarding FEMA's flood mapping program, to ensure that Flood Insurance Rate Maps (FIRMs) reflect the best available science and are based on the best available methodologies for considering the impact of future development on flood risk.

BW-12 requires the FEMA Administrator, on an annual basis, to report to Congress and the Office of Management and Budget (OMB) on (1) the recommendations made by the TMAC, (2) actions taken by FEMA to address such recommendations to improve flood insurance rate maps and flood risk data; and (3) any recommendations made by the TMAC that have been deferred or not acted upon, together with an explanatory statement. See 42 U.S.C. 4101a (l). This report is intended to address this requirement.

The TMAC was responsible for delivering two reports to the FEMA Administrator in 2015: a TMAC 2015 Annual Report and a TMAC 2015 Future Conditions Risk Assessment and Modeling Report. The TMAC issued their first set of recommendations via Interim Reports to FEMA in November 2015. In January 2016, TMAC delivered full reports to FEMA, which provided greater context for the recommendations. The TMAC's reports are available to the public on FEMA's website: **www.fema.gov/tmac**.

Upon receipt of the original recommendations, representatives from offices spanning FEMA's Federal Insurance and Mitigation Administration (FIMA) convened for a full-day work session to begin evaluation of the recommendations and identify themes. Over the next several months, the organization engaged staff from FEMA headquarters and regions, flood mapping program providers, and industry partners for feedback and collaboration on the TMAC's recommendations.

As the initial review was underway, FIMA's Risk Management Directorate (RMD) established a transparent and repeatable framework for evaluating and responding to TMAC's recommendations on an annual basis. The framework aligns TMAC recommendations to the RMD's organizational

structure, and includes a process for accountability, detailed evaluation, reporting and progress documentation, as well as prioritization and sequencing where applicable. The RMD designed the framework with a focus on long-range planning, integration, and collaboration, as many of the TMAC's recommendations are far-reaching and will require internal coordination across Divisions and programs, as well as external coordination with other federal agencies (OFA), state and local governments and Cooperating Technical Partners (CTPs)[1].

Types of Recommendations

The RMD categorized the TMAC's 2015 Annual Report (AR) and Future Conditions (FC) recommendations as follows:

1. Standard Operations – These are recommendations that RMD identified as addressable through current operations or established initiatives. Generally, once initiated, these recommendations are addressable in the near term.
2. Transformative, Science Available – These recommendations cannot be addressed through existing processes or efforts, though the technology and science to implement the recommendation exists. FEMA will prioritize resources and continue to invest in the data and technology needed to implement these recommendations, based upon fund availability. Generally, once initiated, these recommendations are addressable in the medium term.
3. Transformative, Certain Critical Aspects of Science Not Yet Available – These recommendations will require the generation of new science or data to implement. FEMA will prioritize resources and begin strategically investing in the resources needed to implement these recommendations based upon fund availability. Generally, given the resource-intensive nature of these recommendations, FEMA expects they will be implemented in the long term.

2015 TMAC Recommendations and FEMA's Strategy for Implementation

FEMA fundamentally agrees with all of the 2015 TMAC recommendations. The recommendations vary significantly in estimated level of effort and required resources for implementation. Some recommendations offer suggested improvements and refinements to our current operations, while others represent transformational changes for the program. FEMA's strategy for implementation is dependent on budget, priorities and sequencing contingencies, and in some cases, further clarification from the TMAC. FEMA summarizes the implementation approach as follows:

1. Leverage established program initiatives or FEMA's guidance and standards (G&S) maintenance update, to achieve a consistent, routine approach to maintaining and enhancing mapping policies, for recommendations that suggest refinements to current operations or products.

[1] A list of current CTPs may be found at this website, under 'Information by State': https://www.fema.gov/cooperating-technical-partners-program/cooperating-technical-partners-program-0

2. Engage internal and external stakeholders and partners for recommendations that are transformative, as FEMA continues to plan and determine the appropriate sequence and alignment of program changes in support of transformation.
3. Continue to make strategic investments (e.g., in future conditions pilots, technical research, enhanced flood models) and leverage partnerships (such as for high resolution topography, in coordination with the United States Geological Survey (USGS) 3D Elevation Program (USGS 3DEP)), while engaging in strategic, long-term planning to lay the foundation for transformative new mapping polices, products and regulations.

Current Progress and Path Ahead

As of December 2016, FEMA has implemented four of the 29 TMAC' 2015 Recommendations and initiated progress on an additional 18. See the table titled "TMAC Recommendations Reference Guide" in the appendix for additional implementation details.

Addressing the TMAC recommendations has been and will continue to be one of the top priorities for the national flood mapping program. In Fiscal Year 2016 (FY16), FEMA aligned investments with the insights gained from TMAC's 2015 reports and ongoing work. With the additional resources provided by Congress in FY16, FEMA acquired an additional 67,000 stream miles of new, validated, updated engineering; invested in an additional 70,000 square miles of high-resolution topographic coverage; completed large-scale automated engineering for 45,000 stream miles; modernized over 40 counties to a geospatial format; and assessed more than 250,000 expiring or unknown stream miles. These investments continue to lay the foundation for evolving and transforming the mapping program, in accordance with the TMAC's recommendations.

FEMA maintains G&S to support the mapping program. Standards are required elements of a project that support the vision, goals and objectives of the mapping program. Guidance is composed of the recommended methodologies to meet the standards. FEMA is using the semi-annual G&S maintenance update to implement TMAC recommendations whenever possible. For example, FEMA addressed four of the TMAC's 2015 Annual Report recommendations in the November 2016 G&S cycle. The recommendations implemented were:

1. Annual Report recommendation 4 (AR4), which calls for ensuring geospatial data complies with national standards,
2. AR5, which calls for ensuring accuracy of topographic data,
3. AR6, which recommends FEMA periodically review and consider use of publically available models, and
4. AR12, which calls for FEMA to consider cost impacts during G&S updates.

An additional set of recommendations are scheduled for implementation in the November 2017 G&S cycle.

Over the last few years, FEMA has worked diligently to enhance the CTP program within the flood mapping program. FEMA is leveraging newly established coordination mechanisms, such as the CTP Collaboration Center and the CTP Community of Practice (CoP), to address the TMAC's CTP-related recommendations. CTP program enhancements address many of the TMAC's

recommendations. For example, AR19, which calls for FEMA to develop strategies to incentivize CTP participation, will continue to enhance and leverage the existing CTPs and Community Rating System (CRS) programs to promote and increase participation. To implement AR20, which recommends FEMA establish a suite of performance measures for CTPs, FEMA has established a CTP Working Group that analyzed the program's structure and function, resulting in program measures, costs and benefits, and a clearer path forward.

To support a meaningful transformation, FEMA will begin implementation in Fiscal Year 2017 (FY17) of AR2, which calls for a national five-year operations plan. To support flexibility and variance at the regional level while providing consistency at the national level, FEMA regions are developing five-year plans that will inform the development of the national five-year plan. The national five-year operations plan will become a rolling plan that will help FEMA bridge operations from the current status to the desired endpoint as we transform the program. The development of a national five year-operations plan supports and is informed by the implementation of AR3, which calls for the development of program goals and metrics that will help drive investments and behaviors needed to transform the delivery of the flood mapping program. The TMAC recommendations complement and inform emerging efforts established by FEMA, such as an ongoing initiative to redesign risk rating for the NFIP. FEMA considers a new approach to insurance rating and underwriting crucial for the program and has already started identifying the technical considerations for implementation. FEMA's ongoing initiative to analyze technologies, data sources and trends for flood risk quantification will continue in conjunction with the assessment and planning for AR10, which calls for FEMA to transition from the 1 percent annual chance flood as the basis for insurance rating to a structure specific flood frequency determination. The long-term goal is the development of a redesigned risk rating system for the NFIP.

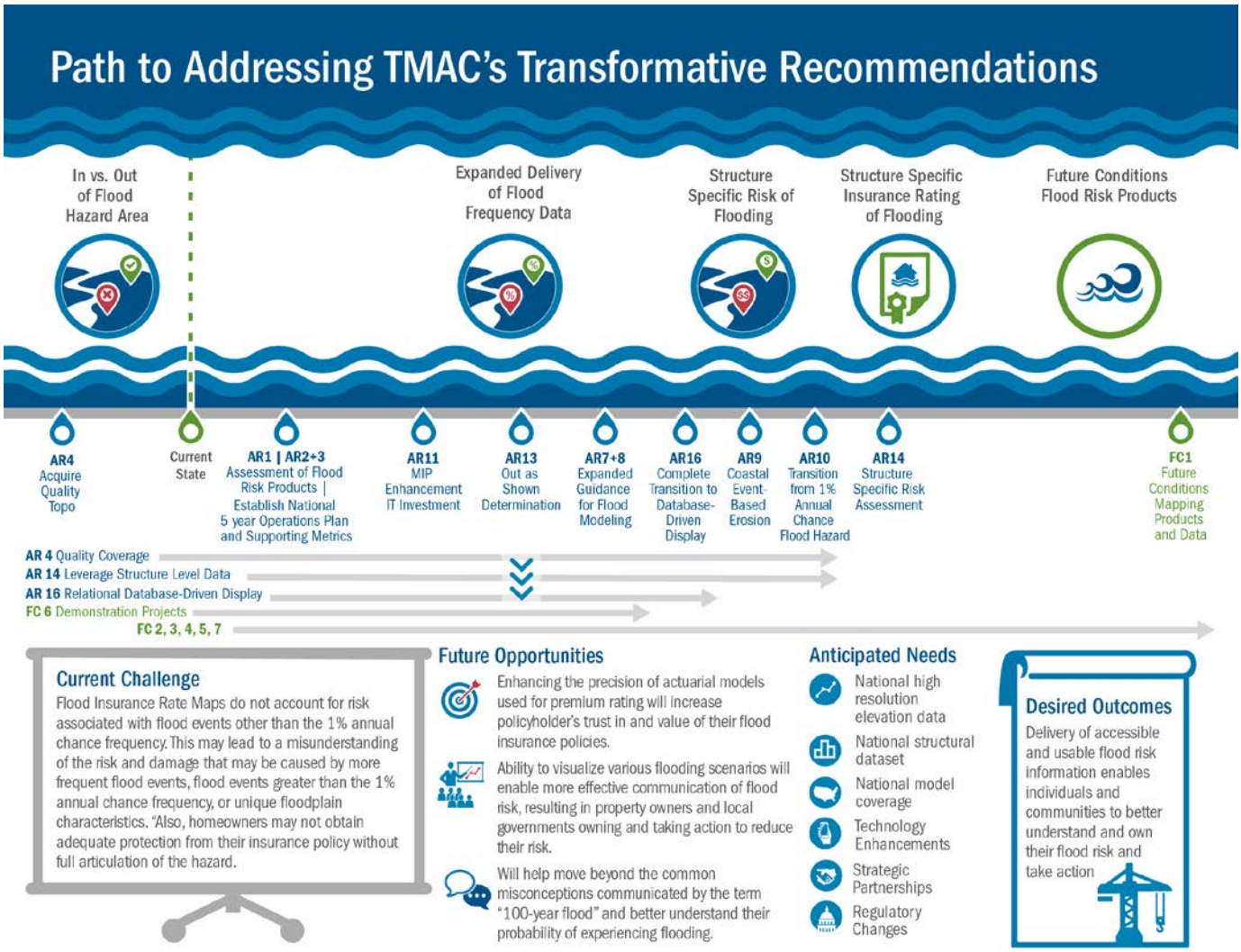
FEMA will continue to invest in more robust modeling that can provide flood risk information for various scenarios in addition to the base flood elevation, one key component in moving toward a redesigned risk rating for the NFIP. FEMA is also making strategic information technology (IT) investments and changes to improve access to and ease of use of the mapping products, as recommended by AR 11 (Update MIP for User-Friendliness) and AR16 (Transition to Digital Display). These investments also ensure that enhancements of FEMA mapping products are interoperable with flood insurance rating mechanisms, mitigation planning initiatives and floodplain management, as called for in AR18 (USGS Streamflow Data), AR5 (Vertical/Horizontal Data Accuracy) and required by AR14 (Structure-Specific Risk Assessments).

FEMA is also laying the foundation for a holistic approach to addressing future conditions mapping and the FC recommendations provided by the TMAC. The Agency is taking care to identify and complement the related efforts of other agencies or stakeholder groups, to avoid redundant or conflicting information. FEMA plans to leverage the completion of pilot studies, per TMAC's FC Recommendation 6, as a way to address many of the issues raised in many of the recommendations and sub-recommendations set forth in the Future Conditions report in addition to Future Conditions initiatives within the Risk Management Directorate. Addressing the research, development, program planning and implementation questions through a series of demonstration projects will lead to an efficient and effective strategy to provide future conditions flood risk products, tools and

information. FEMA recognizes the importance of understanding stakeholder needs, and will leverage research to inform the development of future conditions flood risk products, tools, and information. The TMAC was clear in its FC recommendations to FEMA that future conditions should not appear on the regulatory Flood Insurance Rate Maps (FIRM) at this time. FEMA has been conducting sea level rise pilot studies and is working to identify the specific remaining research gaps to inform the design of additional future conditions demonstration and pilot projects that will address those gaps and inform how FEMA establishes and resources future conditions mapping initiatives.

Program Transformation

The graphic below depicts the transformation of the flood mapping program including the anticipated sequencing of key TMAC recommendations towards the transition from the 1 percent annual chance flood hazard to structure specific flood risk as the basis for insurance ratings.



FEMA Report to Congress on the Technical Mapping Advisory Council's Recommendations from 2015

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I. Legislative Requirement

This document responds to the legislative requirements set forth in the Biggert-Waters Flood Insurance Reform Act of 2012, which states:

> *The Administrator, on an annual basis, shall report to the Committee on Banking, Housing, and Urban Affairs of the Senate, the Committee on Financial Services of the House of Representatives, and the Office of Management and Budget on the—(1) recommendations made by the Council; (2) actions taken by the Federal Emergency Management Agency to address such recommendations to improve flood insurance rate maps and flood risk data; and (3) any recommendations made by the Council that have been deferred or not acted upon, together with an explanatory statement.*

II. Recommendations from the 2015 Annual Report

Annual Report Recommendation 1 (AR1):

FEMA should establish and implement a process to assess the present and anticipated flood hazard and flood risk products to meet the needs of the various users. As part of this process, FEMA should routinely:

a) Conduct a systematic evaluation of current regulatory and non-regulatory products (data, maps, reports, etc.,) to determine if these products are valued by users, eliminating products which do not cost-effectively meet needs;

b) Consider user requirements prior to any updates or changes to data format, applications, standards, products, or practices are implemented;

c) Proactively seek to provide authoritative, easy to access and use, timely, and informative products and tools; and,

d) Consider future flood hazards and flood risk.

FEMA Response: FEMA concurs with this recommendation. Through established initiatives, FEMA is currently addressing certain aspects of AR1. A FEMA Integrated Project Team (IPT) is currently conducting a research effort to improve understanding of how internal and external stakeholders use current FEMA flood risk products. The research will inform potential improvements to enhance access and usability of the products. FEMA's Risk Management Directorate is leading an additional research to evaluate effectiveness of the flood risk products. FEMA and flood mapping partners will leverage the findings of these two research efforts to inform a broad-scale initiative to increase use of the flood risk products to plan and implement mitigation action.

Enhancements to products and outreach will be coordinated in conjunction with FEMA's Guidance and Standards Steering Committee (GSSC), which manages the Risk Management Directorate's (RMD) semi-annual Guidance and Standards (G&S) maintenance update, to ensure product changes are accounted for and consistent across the program, in consideration of user requirements. Implementation will require coordination and integration with the Risk Assessment Program and ongoing regional mapping efforts focused on providing authoritative and informative products and tools.

Responses to the Future Conditions Report recommendations capture the consideration of future flood hazards and flood risks.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years for full implementation excluding consideration for future flood hazards and flood risks. This will coincide with implementation of Future Conditions Recommendation 1 (FC1), which is projected to be a long-term effort.

Annual Report Recommendation 2 (AR2):

FEMA should develop a national five-year flood hazard and risk assessment plan and prioritization process that aligns with program goals and metrics (see Recommendation 3). This should incorporate a rolling five-year plan to include the establishment and maintenance of new and existing studies and assessments in addition to a long-term plan to address the unmapped areas. Mapping and assessment priorities should be updated annually with input from stakeholders (e.g., Multi-Year Hazard Identification Plan). The plan should be published and available to stakeholders.

FEMA Response: FEMA concurs with this recommendation. To support a meaningful transformation of the flood mapping program, in Fiscal Year 2017 (FY17) we will begin development of a national five-year operations plan. The national five-year operations plan will be informed by regional five-year plans to support appropriate flexibility and variance at the regional level while providing consistency at the national level. This five year plan will become a rolling plan that will help us bridge operations from our current status to where we want to go as we transform the program. The development of a five-year operations plan will be supported by the implementation of AR3, which calls for the development of program goals and metrics that will help drive investments and behaviors needed to transform the delivery of our flood mapping program.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years to develop an ongoing implementation plan.

Annual Report Recommendation 3 (AR3):

FEMA should develop National Flood Hazard and Risk Assessment Program goals that include well-defined and easily quantifiable performance metrics. Specifically, the program goals should include metrics for the following:

a) Maintaining an inventory of valid (verified), expiring, unverified and unknown flood hazard miles;

b) Addressing the non-modernized areas of the Nation and unstudied flood hazard miles;

c) Conducting flood risk analysis and assessments on the built environment; and,

d) Counting population having defined floodplains using a stream level performance indicator for a better representation of study coverage.

FEMA Response: FEMA concurs with this recommendation. During FY17, we will begin development of a national five-year operations plan, consistent with the Technical Mapping Advisory Council's (TMAC) AR2. As part of the efforts to develop national and regional five-year operations plans, we will review existing program goals and metrics and revise and develop appropriate goals and metrics to help drive investments and behaviors needed to transform the delivery of the flood mapping program.

FEMA is already addressing the first required measure, "a) Maintaining an inventory of valid (verified), expiring, unverified and unknown flood hazard miles" as FEMA has New, Validated and Updated Engineering (NVUE) data for riverine studies and will report NVUE for coastal studies in the future. FEMA recognizes that although it has NVUE, it does not have a sufficient mechanism for tracking unstudied miles, or miles existing only on paper maps. FEMA will establish a measure that is easy to understand and track for the unmodernized and unstudied miles. FEMA will begin the effort in FY17 that will inform performance measures in FY18.

With respect to the final sub-recommendation, FEMA agrees that developing a metric related to the population that has a defined floodplain would be useful. To fully address this recommendation, research and coordination will be needed to develop a useful measure.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years for full implementation.

Annual Report Recommendation 4 (AR4):

FEMA should work with Federal, State, local, and tribal partners to ensure topographic, geodetic, water-level, and bathymetry data for the flood mapping program are collected and maintained to federal standards. Future FEMA topographic and bathymetric Light Detection and Ranging (LiDAR) acquisition should be consistent with USGS 3DEP and Interagency Working Group on Ocean and Coastal Mapping standards, and all geospatial data for the flood mapping program should be referenced to current national datums and the National Spatial Reference System (NSRS). Water level gage datums for active gages should be referenced to current national datums and the NSRS, and to the extent practical, datums for inactive gages should be converted to meet these standards.

FEMA Response: FEMA concurs with this recommendation. FEMA has standards in place requiring all elevation data to comply with interagency standards, and requiring the use of current national datums. FEMA will continue to work through a variety of interagency working groups to support this recommendation.

Recommendation Type: Standard Operations

Anticipated Timing: Implemented

Annual Report Recommendation 5 (AR5):

FEMA should document the horizontal and vertical accuracy of topographic data input to flood study models and the horizontal and vertical accuracy of topographic data used to delineate the boundaries of the flood themes. These data should be readily available to users, and clearly reported with products.

FEMA Response: FEMA concurs with this recommendation. FEMA has developed changes to the documentation requirements for flood risk projects to include specific reporting requirements for the horizontal and vertical accuracy of elevation data used. FEMA implemented these

requirements in the November 2016 G&S maintenance update. Because of the long timelines for flood risk projects, the results will begin to appear on completed flood mapping projects over the next few years.

Recommendation Type: Standard Operations

Anticipated Timing: Implemented

Annual Report Recommendation 6 (AR6):

FEMA should periodically review and consider use of new publicly available statistical models, such as the proposed Bulletin17C, for flood-frequency determinations.

FEMA Response: FEMA concurs with this recommendation. FEMA leveraged the existing Engineering & Mapping Community of Practice (CoP), a group of FEMA staff and mapping partners that supports ongoing professional learning and sharing of information, to review and consider use of new statistical models. Per the established process, the GSSC reviewed and supported changes or updates to guidance and resulting from acceptance and use of new statistical models in the November 2016 G&S maintenance update. This will be an ongoing activity, and FEMA intends to track, identify and course correct if appropriate, for any potential impacts to ongoing studies and Coordinated Needs Management Strategy (CNMS) validation due to adoption of new modeling methods.

Recommendation Type: Standard Operations

Anticipated Timing: Implemented

Annual Report Recommendation 7 (AR7):

FEMA should develop guidelines, standards, and best practices for selection and use of riverine and coastal models appropriate for certain geographic, hydrologic, and hydraulic conditions.

Riverine:

a) Provide guidance on when appropriate models would be 1-D vs 2-D, or steady state vs unsteady state;

b) Support comparative analyses of the models and dissemination of appropriate parameter ranges; and,

c) Develop quality assurance protocols.

Coastal:

a) Provide guidance on when appropriate models would be 1-D vs 2-D;

b) Support comparative analyses of the models and dissemination of appropriate parameter ranges; and,

c) Develop quality assurance protocols.

FEMA Response: FEMA concurs that it is possible to provide best practices, and potentially guidance, for model selection and use for riverine and coastal flood risk studies. Model use in FEMA's flood hazard studies is governed by 44 Code of Federal Regulations (CFR) 65.6(a)(6) which, in summary, states that for a model to be used, it must have been reviewed and accepted by another governmental agency for flood modeling purposes; it must be well-documented; and it must be available to FEMA and all present and future parties.

FEMA has begun to leverage the existing CoPs (Coastal and Engineering & Mapping) and the subject matter expertise of key external stakeholders such as National Association of Flood and Stormwater Management Agencies (NAFSMA) and Association of State Floodplain Managers (ASFPM) to explore, identify and inventory best practices used by mapping partners, Other Federal Agencies (OFAs), states and local communities. FEMA has learned that overly prescriptive G&S on model selection leads to a loss of innovation and lower quality flood risk information. Additionally, such prescriptive guidance is difficult to maintain accurately as the state of the science evolves. Cognizant of these challenges, FEMA will endeavor to continue to review and highlight additional best practices with regards to model use and selection, while still encouraging study-specific decisions to be made regarding the most appropriate model.

For riverine studies, to accommodate advances in 2D modeling for steady and unsteady state, updates may be required to the Flood Insurance Rate Maps (FIRMs) database, the National Flood Hazard Layer (NFHL) and associated tools and the specifications of Flood Insurance Studies (FIS). As not all current G&S align directly with the outputs from 2D modeling, it is anticipated there would be a learning curve associated with these changes, and implementation could impact engineering and mapping processes. Combined with the recommended disclosure of which models are in use, it is expected that initial implementation of this recommendation could negatively affect study schedules. An outreach strategy to communicate changes, updates and timelines needs to be developed.

Per FEMA's established process, the GSSC will review and support all G&S updates. The November 2016 G&S maintenance cycle resulted in an update to the relevant hydraulics guidance documents. This includes updated information on model selection criteria for 1-D and 2-D model selection. Additional review of best practices and use of 2-D modeling is underway and additional updates to the guidance will occur in the coming year.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years

Annual Report Recommendation 8 (AR8):

FEMA should develop standards, guidelines, and best practices related to coastal 2-D storm surge modeling in order to expand the utility of the data and more efficiently perform coastal flood studies.

FEMA Response: FEMA concurs with the recommendation that guidelines and best practices for coastal 2-D storm surge modeling be developed for coastal flood studies to expand the utility

of the data and more efficiently perform the studies. In fact, FEMA has already begun to take steps to address this recommendation. Coastal Water Levels guidance, released in May 2016, focuses specifically on storm surge modeling, including the statistical treatment of tides in these models. FEMA has existing related guidance and best practices in place and will continue to improve these resources. FEMA is actively prioritizing its effort to address identified needs in coastal 2-D storm surge modeling and in improving study efficiency and data utility.

FEMA acknowledges that to expand the utility, more of the valuable coastal data needs to be readily available. A permanent solution to store, search and disseminate the inventory of coastal data will take several years to implement. Innovation will be necessary to develop a less complex solution. This will be coordinated through FEMA's plan to address Annual Report Recommendation 16 (AR16).

Recommendation Type: Transformative; Science Available

Anticipated Timing: 3 – 5 years

Annual Report Recommendation 9 (AR9):

FEMA should review and update existing coastal event-based erosion methods for open coasts, and develop erosion methods for other coastal geomorphic settings.

FEMA Response: FEMA agrees with this recommendation. We recognize that erosion in all coastal geomorphic settings is important and that FEMA's regulations and standards are in need of an update to reflect present-day knowledge on the subject. This recommendation will require a significant level of effort as coastal research and federal rulemaking may be required for full implementation.

In recent years, FEMA has partnered with the United States Army Corps of Engineers (USACE) to improve an event-based erosion model, CSHORE, for application on the Great Lakes. FEMA incorporated CSHORE into guidance and documentation is available through regional study reports. However, significant research investment to advance the state of the science, and its application on a national scale will be necessary to address this recommendation. FEMA will continue evaluating alternative methodologies and available data, which will require investment in research and testing as well as engagement across federal partners.

Implementation measures may include modifying 44 CFR Section 65.11.

Recommendation Type: Transformative; Certain Critical Aspects of Science Not Yet Available

Anticipated Timing: 5+ years

Annual Report Recommendation 10 (AR10):

FEMA should transition from identifying the 1-percent-annual-chance floodplain and associated base flood elevation as the basis for insurance rating purposes to a structure-specific flood frequency determination and associated flood elevations.

FEMA Response: FEMA concurs with this recommendation and considers the transition to a new approach crucial for the program. This recommendation will require an entirely new approach to insurance rating and underwriting, including new regulatory hazard and risk products and potential impacts on floodplain management standards. There are many technical considerations for implementation requirements, including: (1) appropriate modeling for full probabilistic view of hazard (selected return periods or other solution); (2) whether current methodology is appropriate for biased or higher probability events; and (3) what consideration must be given to levees, dams, tsunamis, etc., for lower probability events that are not currently reflected in the model. Significant outreach to OFAs, academia and private sector resources will be required to develop and test alternative approaches in implementing this recommendation.

FEMA is currently assessing this recommendation in conjunction with an ongoing initiative to analyze technologies, data sources and trends for flood risk quantification toward a long-term goal of developing a redesigned risk rating system for the program. FEMA also kicked off an Integrated Project Team (IPT) in May 2016 to research how to approach implementation of this recommendation. In 2016, FEMA scoped the effort, defined components, and began acquiring data and define resource requirements for 2017 and 2018. In 2017, FEMA will develop and test alternatives through pilot studies, which will incur significant technical costs. In 2018, FEMA plans to select a flood risk rating approach and begin implementation. FEMA is looking at how this recommendation might also address Government Accountability Office (GAO) recommendations and align with the National Academy of Sciences recommendations regarding levees, rating and mapping.

Recommendation Type: Transformative; Science Available

Anticipated Timing: 5+ years

Annual Report Recommendation 11 (AR11):

FEMA should modify the current workflow production process and supporting management system, Mapping Information Platform, to reduce unnecessary delays created by redundant tasks and inflexibility of the system. The process and system are not currently designed to properly manage non-regulatory products or products that do not fit predefined footprints. FEMA should modify the system to enable flexibility in project scope and size, such as the choice of watershed size, not limiting projects to only the hydrologic unit code 8 (HUC8).

FEMA Response: FEMA concurs with this recommendation. FEMA previously recognized the need to update the Mapping Information Platform (MIP), and efforts are already underway. In June 2016, the flood mapping program's Customer and Data Services (CDS) team announced the kick-off of the new MIP studies redesign effort. The MIP is the primary database of all mapping information for the mapping program. Of the three main parts of the MIP: Revisions, Amendments and Studies, the Studies workflow is the part being revised at this time. FEMA acknowledges that the rigid structure of the existing MIP Studies workflow is too inflexible for the evolving needs of the mapping program, and the program needs a more flexible system.

The update will replace the current MIP Studies workflow and allow for the tracking of a wider range of study information. The transition from rigid workflow to a more fluid, iterative process will allow MIP tasks to be completed based on community needs. FEMA subject matter experts (SME) and the Information Technology Risk MAP Systems Team (FIRSTeam) are collaborating with CDS to identify and define solution requirements to ensure success in the long term. The goal is to release the update in 2017.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years

Annual Report Recommendation 12 (AR12):

FEMA, in its update of guidance and standards, should determine the cost impact when new requirements are introduced and provide guidance to consistently address the cost impact to all partners.

FEMA Response: FEMA concurs with this recommendation. Since FEMA formalized the standards for flood risk analysis and mapping as a FEMA policy in 2013, the program costs for implementing new requirements and the possible impacts of implementation of new requirements on ongoing work are formally considered as part of the decision making process. FEMA defines the implementation of new requirements to avoid cost or scope impacts on existing agreements. FEMA has enhanced the documentation of this analysis during the standards process, adding additional language to the policy to clarify the approach to implementation of new requirements on existing agreements and will include more detail on the implementation approach for new standards during the public review of future updates.

Recommendation Type: Standard Operations

Anticipated Timing: Implemented

Annual Report Recommendation 13 (AR13):

FEMA should develop guidelines and procedures to integrate a mass LiDAR-based Letter of Map Amendment (LOMA) process into the National Flood Hazard and Risk Assessment Program. As part of this process, FEMA should also evaluate the feasibility of using parcel and building footprint data to identify eligible “out as shown” structures as an optional deliverable during the flood mapping process.

FEMA Response: FEMA concurs with this recommendation and has taken steps to begin implementing this recommendation. The impacts of this recommendation are far reaching. The creation of new LOMA or study deliverables impacts MT-1 processes, regulatory map production, standard mapping operations, data collection and dissemination, communications and outreach and existing policies and procedures. Additionally, implementation of the recommendation will impact and increase IT, production and standard operations costs, but it is possible that MT-2 costs may be lowered. However, FEMA expects there would be long-term cost savings for MT-1s after an initial increase in costs. There is a potential for implementation

of this recommendation to slow down studies, but add efficiency to LOMA processing; improving credibility and supporting FIMA Customer Experience and Office of the Flood Insurance Advocate efforts. The implementation of this recommendation may have linkage to BW-12 notification requirements, and FEMA will explore this further.

To implement this recommendation, FEMA will establish an IPT and may conduct additional pilot studies to inform program and policy updates needed to support this recommendation. No statutory or regulatory changes are required, and some existing data can be leveraged in support, including: parcel, building footprint, automated engineering data and base flood elevation (BFE) layers. FEMA will need externally sourced parcel data, although complete high resolution topography coverage is not yet available, FEMA is currently collecting available data. FEMA will need to acquire and process data from and in coordination with state and local entities. In evaluating the feasibility of using parcel and building footprint data for identifying eligible "out as shown" structures, requirements for safeguarding personally identifiable information (PII) must be addressed.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years

Annual Report Recommendation 14 (AR14):

FEMA, and its mapping partners including the private sector, should transition to a flood risk assessment focus that is structure specific. Where data is available, FEMA and its partners should contribute information and expertise consistent with their interests, capabilities, and resources toward this new focus.

a) A necessary prerequisite for accurate flood risk assessments is detailed flood hazard identification, which must also be performed to advance mitigation strategies and support loss estimations for insurance rating purposes.

b) FEMA should initiate dialogue with risk assessment stakeholders to identify potential structure-specific risk assessment products, displays, standards, and data management protocols that meet user needs.

c) FEMA and its partners should develop guidelines, best practices, and approaches to implementing structure-specific risk assessments.

FEMA Response: FEMA concurs with this recommendation. Similar to AR10, this recommendation has a structure specific focus. This recommendation will also require an entirely new approach to insurance rating and underwriting, with potential impacts on floodplain management standards. This recommendation expands FEMA's role beyond current location-based hazard products to structure-specific risk products. Risk assessments move beyond hazard data and will require a technical approach to vulnerability and consequence. FEMA must consider the appropriate role for the Agency, communities, property owners and other

stakeholders as well as the spectrum of providing hazard data, risk framework, components of risk assessment or the entire risk assessment.

FEMA will take the same approach as AR10, aligning the assessment and implementation with the ongoing initiative to redesign the FEMA risk rating system and the IPT established in May 2016. The timeline will be concurrent with AR10, with scoping efforts, data acquisition and defined resource requirements occurring in 2016, development and testing of alternatives occurring in 2017, and selection of the approach and beginning of implementation occurring in 2018. FEMA anticipates that implementation will require significant outreach with OFAs, academia and private sector resources.

Recommendation Type: Transformative; Science Available

Anticipated Timing: 3 – 5 years

Annual Report Recommendation 15 (AR15):

FEMA should leverage opportunities to frame and communicate messages to stakeholders in communities so they understand the importance of addressing the flood risk today and consider long-term resilience strategies. Messages should be complemented by economic incentives such as low-interest loans and mitigation grants that lead community leaders and individuals to undertake cost-effective risk reduction measures.

FEMA Response: FEMA fundamentally agrees with this recommendation and has taken steps to address and advance flood risk communication and encourage risk reduction and long-term resilience strategies. In support of this, FEMA will continue to implement its National Outreach Strategy. The strategy aims to create an environment where communities can understand their risks and the importance of addressing them; are more willing to engage with FEMA to analyze their risks; and are better positioned to take action to increase their community's resilience.

To this end, FEMA has formed a Resilient Nation Partnership Network to activate a national conversation around the importance of resilience and to help foster mitigation action at the community level. The Resilient Nation Partnership consists of organizations and individuals united by a common goal, to inform and educate communities across the country about resilience and motivate them to take action to protect their communities from the loss of life, property and prosperity as a result of natural disasters.

FEMA has also established the Risk Mapping, Assessment, and Planning (MAP) Mitigation Action CoP, a group of problem solvers that promote risk reduction actions. This group has nationwide representation, including FEMA headquarters and regional staff and their CTPs and private sector expert support.

FEMA will continue to leverage *Ready*, a national public service campaign designed to educate and empower Americans to prepare for and respond to emergencies including natural and man-made disasters. Launched in 2003, the goal of this campaign is to get the public involved and increase the level of basic preparedness across the nation. Partnerships with a wide variety of

public and private organizations support the campaign. FEMA distributes *Ready* campaign messages via television, radio, print, and outdoor and web public service announcements (PSAs).

Expanding mitigation and resilience through opportunities to leverage grants, loans and rebates and other incentives will require collaboration between FEMA, the private sector and OFAs. Providing further incentives through Hazard Mitigation Assistance (HMA) grants would likely require funding and authorization. FEMA does not offer disaster loan programs but will look to existing federal programs, such as those with the Small Business Administration and Housing and Urban Development and explore opportunities to facilitate, communicate, and promote related loan options to communities.

FEMA will continue to evaluate opportunities to further implement AR15.

Recommendation Type: Standard Operations

Anticipated Timing: Implementation ongoing

Annual Report Recommendation 16 (AR16):

FEMA should transition from the current panel-based cartographic limitations of managing paper maps and studies to manage National Flood Insurance Program (NFIP) data to a database-derived, digital-display environment that are fully georeferenced and relational, enabling a single digital authoritative source of information and database-driven displays. Towards this transition, FEMA should:

a) Prepare a multi-year transition plan to strategically transition all current cartographic and/or scanned image data to a fully georeferenced, enterprise relational database.

b) Update required information for map revisions (MT-2 application forms) and Letter of Map Changes (LOMCs) applications to ensure accurate geospatial references, sufficient data to populate databases, and linkages to existing effective data.

c) Adopt progressive data management approaches to disseminate information collected and produced during the study and revision process, including LOMCs.

d) Ensure that the data management approach described in (c) is sufficiently flexible to allow efficient integration, upload, and dissemination of NFIP and stakeholder data (e.g., mitigation and insurance data that are created and maintained by OFA), and serve as the foundation for creating all digital display and mapping products.

e) Provide a mechanism for communities to readily upload jurisdictional boundary data, consistent with requirements to participate in the NFIP, as revised, allowing other stakeholders access.

FEMA Response: FEMA concurs with this recommendation although implementation will require significant investments in IT updates and in hydrologic and hydraulic (H&H) study updates, as well as ongoing and new investment in staffing resources to plan and oversee implementation. FEMA will conduct research to understand the needs and potential impacts to

states and local municipalities including data capture requirements and standards for stakeholder data sharing. FEMA will use this research to inform the development of a strategy for how to transition from existing paper inventories to a database-derived digital display environment. Updates will be required to multiple platforms including the Flood Risk Study Engineering Library (FRSEL), the Map Service Center (MSC), and the National Flood Hazard Layer (NFHL) viewer. MT-2 application forms, used for Conditional Letters of Map Revisions (CLOMRs) and Letters of Map Revisions (LOMRs), will also require updating. Enhanced integration among platforms will be required, such as the integration of the FRSEL data geospatially into the newly updated NFHL viewer and the MSC updates to feature the NFHL over legacy maps.

Recommendation Type: Transformative; Science Available

Anticipating Timing: 3 – 5 years

Annual Report Recommendation 17 (AR17):

FEMA should consider National Academy of Public Administration (NAPA) recommendations on agency cooperation and federation (6, 7, 8, 9, 13 and 15) and use them to develop more detailed interagency and intergovernmental recommendations on data and program-related activities that can be more effectively leveraged in support of flood mapping.

FEMA Response: FEMA concurs with this recommendation and anticipates that implementation of this recommendation will require devoted resources including geospatial and flood engineering staff to support the identification and prioritization of interagency coordination opportunities, to understand the structure and operations of OFA committees and working groups, and to inform the development of an interagency engagement approach that aligns with partner agencies.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years

Annual Report Recommendation 18 (AR18):

FEMA should work with federal, state, local, and tribal agencies, particularly the U.S. Geological Survey (USGS) and the National Ocean Service, to ensure the availability of the accurate water level and streamflow data needed to map flood hazards. Additionally, FEMA should collaborate with USGS to enhance the National Hydrography Dataset to better meet the scale and resolution needed to support local floodplain mapping while ensuring a consistent national drainage network.

FEMA Response: FEMA concurs with this recommendation. FEMA plans to coordinate through existing relationships, such as the Integrated Water Resources Science and Services (IWRSS) consortium among the United States Army Corps of Engineers', National Oceanic and Atmospheric Administration (NOAA), USGS, and FEMA, to identify and prioritize data needs, define expectations and desired outcomes and, in collaboration with OFAs, offer support and

input to the development of an approach to provide streamlined data from flood studies to update the National Hydrography Dataset and the NOAA National Water Model.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years

Annual Report Recommendation 19 (AR19):

FEMA should develop and implement a suite of strategies to incentivize communities, non-government organizations and private sector stakeholders to increase partnering and subsequent contributions for flood hazard and risk updates and maintenance.

FEMA Response: FEMA concurs with this recommendation and will continue to enhance and leverage the existing CTPs and Community Rating System (CRS) programs to address this recommendation. The CTP program establishes partnerships between FEMA and participating NFIP communities, regional and state agencies, tribes and universities to increase participation in the flood hazard mapping program. The CTP program, established in 1999, is means of extending limited mapping funding and increasing local involvement in the creation of (Flood Insurance Rate Maps (FIRMs) and Digital Flood Insurance Rate Maps (DFIRMs). The objectives of the program are to maintain consistent national standards while enabling a tailored, local focus by involving local communities to provide training and technical assistance, and leveraging valuable local experience, knowledge, and data to facilitate floodplain management and maintenance.

In 2015, the CTP program underwent a series of enhancements, including the establishment of the CTP Collaboration Center, an online Microsoft SharePoint portal for information-sharing and discussion and the release of a training-focus CTP webinar series. Additionally, FEMA launched a CTP CoP to serve as a feedback mechanism and forum for information sharing, collaboration and training for CTP stakeholders and developed a draft system with the intent to categorize, define and offer targeted incentives for CTP partners. The program is using performance measures to evaluate partners and identify areas of opportunity and improvement. FEMA will use the performance measures outcomes to inform the award of FY17 CTP grants. While the CTP program is not currently designed for non-governmental private sector partners, innovation of the program to develop methods to incentivize the CTPs to increase those partnerships through their coordination efforts is required. At present, FEMA is standing up two initiatives to highlight high-performing CTPs in the field of innovative partnership and to share best practices and lessons learned between CTPs. Additional initiatives will be planned for FY18 and beyond.

CRS, established in 1990, is a voluntary program offered to NFIP-participating communities. It rewards floodplain management activities exceeding the minimum NFIP standards with discounted flood insurance rates that reflect the reduced flood risk resulting from the communities' mitigation actions. The CRS already incentivizes NFIP participating communities for doing flood hazard data development; FEMA will continue to look for additional possible integration points.

While both programs are inherently incentive-based, FEMA will continue to identify opportunities to develop and implement innovative strategies that entice participation and high-performance in both programs.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years

Annual Report Recommendation 20 (AR20):

FEMA should work with CTPs to develop a suite of measures that communicate project management success, competencies, and capabilities of CTPs. Where CTPs demonstrate appropriate levels of competencies, capabilities and strong past performance, FEMA should further entrust additional hazard identification and risk assessment responsibilities to CTPs.

FEMA Response: FEMA concurs with this recommendation and is already addressing most aspects. In 2015, FEMA established a CTP Working Group comprised of FEMA leadership from headquarters and the regions to analyze the program's structure and function. As a result of a thorough evaluation of program measures, costs and benefits, and CTPs' functions across the regions, the CTP Program has a clearer path forward. The group conducted additional evaluation via a CTP Program Feedback Survey distributed to both internal and external program stakeholders. Results of the survey, captured in the CTP Program Feedback Survey Report, indicate that both FEMA and CTPs want to bring innovation to the program through new technologies, funding flexibility, improved collaboration and information sharing and enhanced training opportunities to increase stakeholder efficiencies and knowledge.

The Feedback Survey Report includes recommendations that outline innovative ways to make the program more robust and more sustainable, as well as "Next Steps," an aggressive, yet achievable list of initiatives, many of which have already been initiated and will be strategically executed through a National Five-Year Operations Plan. A few examples of these initiatives include the CTP CoP, the CTP Collaboration Center and the training webinar series. FEMA also developed an outreach strategy to generate awareness and increase transparency of the CTP Program through monthly email communication updates and quarterly calls with CTP stakeholders.

FEMA incorporated the program performance measures informed by the 2015 CTP Program Feedback Survey to the FY2016 Notice of Funding Opportunity (NOFO) for CTP grants. The measures will be evaluated and possibly refined on an annual basis for future NOFOs, and to account for flexibility that reflects variability in CTP competency, capability and function for different types of CTPs within the program. To better capture CTP performance and value, FEMA is exploring standard guidance for regions entering Risk MAP data into systems of record.

FEMA acknowledges that the TMAC's Annual Report indicates a desire for more consistent funding awareness for CTPs. FEMA funds the CTP program through annual appropriations and

seeks to leverage CTP's own efforts and capabilities. To encourage CTP applicants, FEMA will investigate other opportunities and recognize CTP efforts.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years

Annual Report Recommendation 21 (AR21):

To ensure strong collaboration, communication, and coordination between FEMA and its CTP mapping partners, FEMA should establish a National Flood Hazard and Risk Management Coordination Committee. The role of the committee should be focused around the ongoing implementation of the five-year Flood Hazard Mapping and Risk Assessment Plan. FEMA should add other members to the committee that have a direct bearing on the implementation of the plan.

FEMA Response: FEMA is exploring existing venues to accommodate this coordination committee; however, it would be premature to establish such a committee before FEMA implements the five-year flood hazard mapping and risk assessment plan, consistent with AR2, which is a focus for FEMA in 2017.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years

Annual Report Recommendation 22 (AR22):

FEMA should define the financial requirements to implement the TMAC's recommendations and to maintain its investment in the flood study inventory.

FEMA Response: FEMA concurs with this recommendation. Defining budgetary requirements is part of the program planning process and FEMA will factor the estimated costs of implementation of TMAC recommendations to the prioritization, sequencing and investments decisions in support of implementation planning, consistent with the overall federal budget process.

Recommendation Type: Standard Operations

Anticipated Timing: 1 – 3 years

III. Recommendations from the 2015 Future Conditions Risk Assessment and Modeling Report

The TMAC's recommendations from the Future Conditions Risk Assessment and Modeling Report are far reaching. They will push the state of the science, and the state of FEMA's capabilities, to new heights. While FEMA agrees with the TMAC that the recommendations would result in improved service of the NFIP communities, the resources required for full implementation will be substantial. To give these recommendations the full weight of the consideration that they are due, FEMA will continue working with the TMAC in 2017 to better understand and refine these recommendations. In addition, FEMA will continue laying the groundwork for such a substantial undertaking through collaboration with internal and external partners.

Future Conditions Recommendation 1 (FC1):

Provide future conditions flood risk products, tools and information for coastal, Great Lakes and riverine areas. The projected future conditions should use standardized timeframes and methodologies wherever possible to encourage consistency and should be adapted as actionable science evolves.

FEMA Response: FEMA agrees that distribution of future conditions flood risk products, tools and information for coastal, Great Lakes and riverine environments could provide value to communities. FC1 is the most substantial of the FC recommendations, and all subsequent FC recommendations support the implementation of FC1. By requesting that FEMA add future conditions assessments, modeling and mapping, the TMAC is requesting that FEMA drive and push both the state of the science and the state of application of the science on a broad scale.

Implementation of FC1 will require significant resources and will require a comprehensive and well-planned approach. Addressing this recommendation will require a substantial investment by FEMA in active fields of research, which FEMA has not historically done on this scale. It will also require a lengthy amount of time, as credibly changing the state of the science cannot be done overnight. While FEMA will look to leverage all of the available existing science, applying it on the scale and to the level of accuracy recommended by the TMAC will require much further investment. FEMA will not pursue piecemeal implementation of the associated recommendations. Rather, a focus on implementing FC6 (performing demonstration projects) will be a way to plan for and, over time, develop a program that will accomplish the goals identified by the TMAC in FC1. In summary , prioritizing and implementing FC6 addresses FC Recommendations 2 through 7 and leads to the implementation of FC1.

Recommendation Type: Transformative; Certain Critical Aspects of Science Not Yet Available

Anticipated Timing: 10+ years

Future Conditions Recommendation 2 (FC2):

Identify and quantify accuracy and uncertainty of data and analyses used to produce future conditions flood risk products, tools, and information.

FEMA Response: While FEMA concurs with this recommendation, identifying and quantifying uncertainty in the production of future flood risk information is a significant undertaking. Simply producing the future conditions information will push the state of the science; to accomplish this recommendation, FEMA will need close coordination with OFAs and research scientists in this field. Implementation of this recommendation can begin once appropriate methodologies to credibly accomplish FC1 have been identified.

Recommendation Type: Transformative; Certain Critical Aspects of Science Not Yet Available

Anticipated Timing: 10+ years

Future Conditions Recommendation 3 (FC3):

Provide flood hazard products and information for coastal and Great Lakes areas that include the future effects of long-term erosion and sea/lake level rise. Major elements are:

- Provide G&S for the development of future conditions coastal flood hazard and risk products.
- Incorporate local relative sea/lake level rise scenarios and long-term coastal erosion into coastal flood hazard analyses.
- Consider the range of potential future natural and manmade coastal changes, such as inundation and coastal erosion.

FEMA Response: FEMA agrees that coastal and Great Lakes communities would likely be interested in this information, where similar products have not already been developed and distributed through Risk MAP or are not available through OFAs or the private the sector. FEMA has begun partially or wholly addressing some of the sub-recommendations contained in FC3. For example, FEMA is currently performing three sea level rise (SLR) pilots that involve coordination with OFAs and include community consultation. The SLR pilots build upon existing conditions analyses, use global mean sea level scenarios and use a simple impact viewer tool to determine future flood hazard estimates.

In addition, FEMA recently compiled a summary of existing sea level rise and shoreline change studies in an effort to understand the state of the science and its potential implications on flood hazards identification. FEMA-sponsored sea level rise studies were reviewed as well as numerous studies conducted by other federal, state, and local agencies and private organizations. The summary is intended to inform future FEMA studies, suggest where there are opportunities to leverage existing data, and to support the advancement of recommendations made by the TMAC.

FEMA is planning for the initiation of additional SLR pilots in 2018, which build on the lessons learned to date. These pilots, per FC6, will allow FEMA to identify and address methodological

gaps, and to test the state of science (especially as relates to including long-term erosion with sea level rise) and demonstrate to stakeholders the type of information that may be delivered to them.

At present, FEMA provides the Increased Flooding Scenarios flood risk product to many communities. This product, which is a form of the linear superposition approach to SLR assessment, identifies areas that are likely to flood if the flood is larger than with a 1 percent annual chance flood. FEMA works with the communities to select up to three scenarios for this product that would be the most useful to the community and their hazard mitigation and resilience planning efforts.

Recommendation Type: Transformative; Certain Critical Aspects of Science Not Yet Available

Anticipated Timing: 10+ years

Future Conditions Recommendation 4 (FC4):

Provide future conditions flood risk products and information for riverine areas that include the impacts of: future development, land use change, erosion, and climate change, as actionable science becomes available. Major elements are:

- Provide G&S for the development of future conditions riverine flood risk products.
- Future land use change impacts on hydrology and hydraulics can and should be modeled with land use plans and projections, using current science and build upon existing model study methods where data are available and possible.
- Future land use should assume built-out floodplain fringe and take into account the decrease of storage and increase in discharge.
- No actionable science exists at the current time to address climate change impacts to watershed hydrology and hydraulics. If undertaken, interim efforts to incorporate climate change impacts in flood risk products and information should be based on existing methods, informed by historical trends, and incorporate uncertainty based upon sensitivity analyses.

Where sufficient data and knowledge exist, incorporate future riverine erosion (channel migration) into flood risk products and information.

FEMA Response: FEMA agrees with this recommendation and concurs that there is a need for such products, which will grow as actionable science for these purposes becomes available. To date, FEMA has already, or is currently, addressing several of the sub-recommendations of FC4. In 2001, FEMA issued a rule titled “Changes to General Provisions and Communities Eligible for the Sale of Insurance Required to Include Future-Conditions Flood Hazard Information on Flood Maps.” 66 FR 59166 (Nov. 27, 2001). This rule allows communities to use future conditions hydrology resulting from land use development, for mapping purposes (FC sub-recommendation 5-6). With regards to encouraging communities to adopt future conditions

products (FC sub-recommendation 5-17), FEMA encourages communities to address future conditions by offering incentives via the CRS program.

FEMA will look for opportunities to leverage knowledge gained during the development of the Federal Flood Risk Management Standard (FFRMS) to inform future conditions product development and delivery. To further address FC4, FEMA will look to leverage existing case studies from states such as Indiana, Vermont, and Washington that have examined long-term riverine erosion to identify how these states were able to assess and provide this information to their communities.

As TMAC articulates in their recommendations, FC4 will push the state of the science. FEMA will require time, money and dedicated staff resources to implement this recommendation fully in riverine environments.

Recommendation Type: Transformative; Certain Critical Aspects of Science Not Yet Available

Anticipated Timing: 10+ years

Future Conditions Recommendation 5 (FC5):

Generate future conditions data and information such that it may frame and communicate flood risk messages to more accurately reflect the future hazard in ways that are meaningful to and understandable by stakeholders. This should enable users to make better-informed decisions about reducing future flood-related losses.

FEMA Response: FEMA concurs with this recommendation and will leverage ongoing risk communication efforts to inform a communications strategy that will address future conditions and meaningfully communicate future flood hazards.

Upon finalization of a future conditions strategy informed by the other TMAC recommendations, FEMA will need to develop an outreach and communications strategy for communicating future conditions flood risk that is applicable at the national, regional, and local levels. Each community will have varied, unique needs and it is important that FEMA understand these during community engagement. Implementing the strategy would potentially include new messaging, visuals and infographics, as well as related documentation and communication tools. FEMA will also need to evaluate the effectiveness of communicating risk through flood risk products and other tools in different and more consumable formats (e.g., probability). Additionally, FEMA will reach out to OFAs involved in the future conditions space, such as National Oceanic and Atmospheric Administration (NOAA) and USGS, to leverage what they have already developed through outreach and messaging of future flood risk. Finally, in 2017 FEMA is initiating an analysis of existing sea level rise communication efforts already underway by OFAs, state agencies and private organizations to inform the strategy to address this recommendation.

Additional resource investments will be required to add data storage capacity; to develop scenario-based analyses to understand the impacts of future conditions flooding and of different

decisions for the future; to produce materials and develop products for web-based communication; and to fund comprehensive research and testing to ensure that messages about future flood risks are meaningful and understandable by stakeholders. Close coordination with the Office of Management and Budget and the Department of Homeland Security (DHS) will be required during this engagement.

Recommendation Type: Transformative; Certain Critical Aspects of Science Not Yet Available

Anticipated Timing: 10+ years

Future Conditions Recommendation 6 (FC6):

Perform demonstration projects to develop future conditions data for representative coastal and riverine areas across the nation to evaluate the costs and benefits of different methodologies or identify/address methodological gaps that affect the creation of future conditions data.

FEMA Response: FEMA concurs with this recommendation and envisions that implementation of FC6 can be performed in a way that it addresses the majority of the other recommendations and sub-recommendations found in the Future Conditions Risk Assessment and Modeling Report. FEMA will leverage results from previous FEMA-initiated sea level rise and future conditions demonstration projects to address and inform the other FC recommendations. However, to address the significant breadth and depth of the research needed to implement FC1, a more robust research and demonstration project effort will be needed. This effort will require integrated planning and consideration, taking into account FEMA's priorities, the state of the science and research needs, as well as possible partnerships with OFA. The near-term steps for implementing FC6 include:

1. Developing a framework for the research and demonstration projects including defining goals and objectives, scope, required resources, and timelines.
2. Identifying priorities and sequencing of demonstration projects (e.g. focusing on sea level rise prior to river or inland future conditions, etc.).
3. Identifying opportunities for engaging and/or partnering with OFA, industry associations, and local communities.
4. Determine staff, budget and contracting requirements.

The level of effort to implement FC6 will be substantial.

Recommendation Type: Transformative; Science Available

Anticipated Timing: 3 – 5 years

Future Conditions Recommendation 7 (FC7):

Data and analysis used for future conditions flood risk information and products should be consistent with standardized data and analysis used to determine existing conditions flood risk, but also should include additional future conditions data, such as climate data, sea level rise

information, long-term erosion data; and develop scenarios that consider land use plans, planned restoration projects, and planned civil works projects, as appropriate, that would impact future flood risk.

FEMA Response: FEMA concurs with this recommendation and will look to collaborate with OFAs, perhaps via the Advisory Committee on Water Information (ACWI), to support research efforts for new methods of incorporating future conditions data to future conditions mapping and products. For coastal studies, FEMA already has a strong partnership with NOAA, USACE and the US Global Change Research Program, which can be leveraged to develop the standardized data, analysis and products described. Because other recommendations provided by TMAC may fundamentally shift how FEMA performs flood risk studies in the future, it is important that studies of future flood conditions are performed in a manner that is consistent with, or complementary to, on-going evolutions in FEMA's study methods.

Recommendation Type: Transformative; Certain Critical Aspects of Science Not Yet Available

Anticipated Timing: 10+ years

Appendix A. TMAC Recommendations Reference Guide

FEMA developed the table below to act as a convenient, truncated reference guide for how each Annual Report (AR) and Future Conditions Report (FC) recommendation has been categorized as well as a brief summary of the proposed implementation actions. The Reference Guide is subject to change.

Rec. #	Rec Description	Status	Rec. Category	Strategy	Implementation Action
Annual Report (AR)					
AR 1	Assess present and anticipated user needs for products	Initiated	Standard Operations	Guidance & Standards (G&S)	Flood Risk Products Integrated Project Team is evaluating user needs and assessing value/use of current product offerings.
AR 2	Develop national five-year plan and prioritization process	Initiated	Standard Operations	Program planning	In FY17, FEMA regions and headquarters will begin developing five-year plans that will have a rolling implementation.
AR 3	Develop national program goals that include well defined and easily quantifiable metrics	Initiated	Standard Operations	Program planning	As part of the five-year planning in FY17, FEMA is revising/developing program goals and metrics.
AR 4	Ensure geospatial data complies with national standards	Implemented	Standard Operations	Guidance & Standards (G&S)	Addressed any specific concerns/issues in the November 2016 G&S maintenance update.
AR 5	Ensure accuracy of topographical data	Implemented	Standard Operations	Guidance & Standards (G&S)	Coordinated with the Regulatory Products Team to determine where the information should be reported and how to revise the data capture requirements. Addressed in the November 2016 G&S maintenance update.
AR 6	Periodically review and consider use of publicly available models	Implemented	Standard Operations	Guidance & Standards (G&S)	Addressed in the November 2016 G&S update although this will be an ongoing activity. FEMA will track, identify and course correct for any potential impacts to ongoing studies and CNMS validation due to adoption of new modeling methods.
AR 7	Develop guidelines, standards, best practices for selection and use of models	Initiated	Standard Operations	Guidance & Standards (G&S)	Leveraging existing Community of Practices (CoPs) and other subject-matter experts (SMEs) to identify and inventory best practices. Partially addressed in the November 2016 G&S maintenance update.
AR 8	Coastal 2-D Storm Surge modeling guidance	Initiated	Transformative; Science Available	Research, planning and investments	Existing best practices will be captured and cataloged, and new guidance may be developed as the topics in the Coastal Technical Risk Register are addressed.

Rec. #	Rec Description	Status	Rec. Category	Strategy	Implementation Action
AR 9	Coastal event erosion methods	Not yet Initiated	Transformative; Science Not Yet Available	Research, planning, rulemaking	Coastal research will be required. FEMA will continue evaluating new methodologies for event-based erosion
AR 10	Transition from 1% to Structure specific flood frequencies	Initiated	Transformative; Science Available	Investments, research, planning, rulemaking	FEMA will continue research in support of implementation of this recommendation. Requires national high res topo, structural elevation data, and models.
AR 11	Modify production processes and Mapping Information Platform (MIP)	Initiated	Standard Operations	Guidance & Standards (G&S)	Mapping Information Platform (MIP) Redesign is already underway. FEMA is collaborating with Customer and Data Services (CDS) to define solution requirements and goal is to release update via the November 2017 G&S maintenance update.
AR 12	Consider cost impacts during G&S updates	Implemented	Standard Operations	Guidance & Standards (G&S)	Costs are already factored into G&S but the process has been formalized by the Nov 2016 G&S maintenance update.
AR 13	Mass Lidar LOMA process	Initiated	Standard Operations	Research planning and Guidance & Standards (G&S)	Pilot studies will inform development of G&S, to be implemented in the November 2017 maintenance update.
AR 14	Structure specific flood risk assessment focus	Initiated	Transformative; Science Not Yet Available	Investments, research, planning, rulemaking	Require an entirely new approach to insurance rating and underwriting. Requires national high resolution topography, structural elevation data, and models. Planning (scoping, data acquisition, defining resource requirements) is underway.
AR 15	Enhanced communication of flood risk to stakeholders	Initiated	Standard Operations	Guidance & Standards (G&S)	Leveraging Community Engagement and Risk Communication (CERC) and the Mitigation Action Community of Practice to address this via the November 2017 G&S maintenance cycle.
AR 16	Transition to database derived digital display environment	Initiated	Transformative; Science Available	Investments, research, & planning	Planning (scoping, data acquisition, defining resource requirements) is underway. Will require significant investment and updates to multiple platforms and processes.
AR 17	Consider National Academy of Public Administration (NAPA) recommendations	Initiated	Standard Operations	Research, planning	Staff will support identification and prioritization of interagency coordination opportunities to inform the development of an interagency engagement approach that aligns with partner agencies.
AR 18	Ensure accurate water level and streamflow data	Initiated	Standard Operations	Research and Guidance & Standards (G&S)	Research is underway to identify and prioritize data needs and define expectations in collaboration with Other Federal Agencies (OFAs). Will be

Rec. #	Rec Description	Status	Rec. Category	Strategy	Implementation Action
					addressed in November 2017 G&S maintenance update.
AR 19	Incentives to increase partnering	Initiated	Standard Operations	Cooperating Technical Partner program enhancements	Enhancements to the Cooperating Technical Partner (CTP) program address this recommendation and FEMA will continue to look for opportunities for improvements.
AR 20	Suite of measures for Cooperating Technical Partners	Initiated	Standard Operations	Cooperating Technical Partner program enhancements	Enhancements to the Cooperating Technical Partner (CTP) program address this recommendation and FEMA will continue to look for opportunities for improvements.
AR 21	Establish National Flood Hazard Risk Management Coordination Committee	Initiated	Standard Operations	Cooperating Technical Partner program enhancements	Exploring whether the existing Cooperating Technical Partner (CTP) Community of Practice and its charter could achieve this recommendation.
AR 22	Define financial requirements to implement the Technical Mapping Advisory Council's (TMAC) recommendations	Initiated	Standard Operations	Program planning	In support of implementation AR2 and other recommendations that require investment/devoted resources, FEMA is developing pricing estimates for all of the recommendations.
Future Conditions (FC) Recommendations					
FC 1	Provide future conditions flood risk products, tools, and information for coastal, Great Lakes, and riverine areas	Not Yet Initiated	Transformative; Certain Critical Aspects of Science Not Yet Available	Research, planning and Guidance & Standards (G&S)	Will be informed by implementation of FC6.
FC 2	Identify and quantify accuracy and uncertainty of data and analyses	Not Yet Initiated	Transformative; Certain Critical Aspects of Science Not Yet Available	Research, planning, and investments	Will be informed by implementation of FC6.
FC 3	Incorporate effects of long-term erosion and sea/lake level rise in future conditions products/info	Not Yet Initiated	Transformative; Certain Critical Aspects of Science Not Yet Available	Research, planning, and investments	Will be informed by implementation of FC6.
FC 4	Incorporate future development, land use change, erosion, and climate change to future conditions products/info	Not Yet Initiated	Transformative; Certain Critical Aspects of Science Not Yet Available	Research, planning, and investments	Will be informed by implementation of FC6.

Rec. #	Rec Description	Status	Rec. Category	Strategy	Implementation Action
FC 5	Frame future conditions data/info/ messaging to inform stakeholders of risk and inform mitigation action	Not Yet Initiated	Transformative; Certain Critical Aspects of Science Not Yet Available	Research, planning and Guidance & Standards (G&S)	Will be informed by implementation of FC6.
FC 6	Perform demonstration projects to develop future conditions data	Initiated	Transformative; Science Available	Research and planning	Conducting sea level rise (SLR) pilots and demonstration projects and will leverage the information gained to inform additional pilots as well as the implementation of the other FC recommendations.
FC 7	Future conditions data should be consistent with standardized data and analysis	Not Yet Initiated	Transformative; Certain Critical Aspects of Science Not Yet Available	Research, planning and Guidance & Standards (G&S)	Will be informed by implementation of FC6.